

RECLAMATION

Managing Water in the West

Reclamation Quagga Mussel Activities



U.S. Department of the Interior
Bureau of Reclamation

Reclamation's Mission

The core mission of the Bureau of Reclamation is to operate and maintain projects to ensure continued delivery of water and power benefits to the Western States

- Reclamation delivers 10 trillion gallons of water to more than 31 million people each year**
- Reclamation is the second largest producer of hydro-electric power in the Western U.S.**

Reclamation Assets

- **348 storage reservoirs**
- **254 diversion dams**
- **16,075 miles of canals**
- **1,460 miles of pipelines**
- **280 miles of tunnels**
- **37,495 miles of laterals**
- **17,040 miles of project drains**
- **268 pumping plants over 1,000 horsepower**
- **58 hydroelectric powerplants**

Reclamation Research

- **Monitoring & Detection Improvements**
 - PCR – Methods to extract target DNA
 - Microscopy – Veliger viability & larval enumeration
- **Emphasis on Facilities Protection**
 - Coatings testing
 - Field evaluation of filtration technologies
 - Field evaluation of UV treatment technologies
 - Field evaluations of promising bacterial product derived from *Pseudomonas fluorescens* (Pf)
 - Other control methods
- **Ecological Impacts**
 - Mussel survival & transport in water delivery systems
 - Impacts of physical, chemical, and biological attributes on mussel distribution

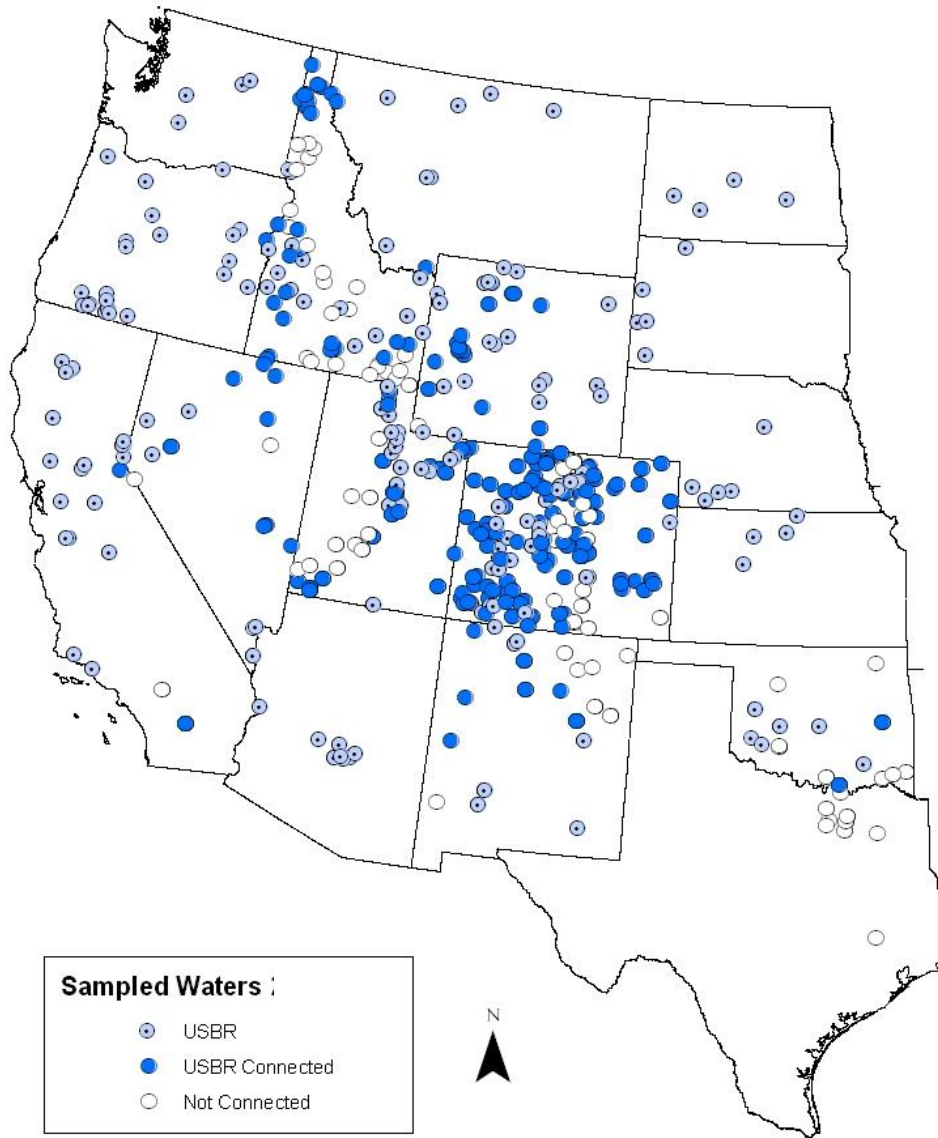
2007-2013

**425 water bodies
sampled by USBR, State
and local partners**

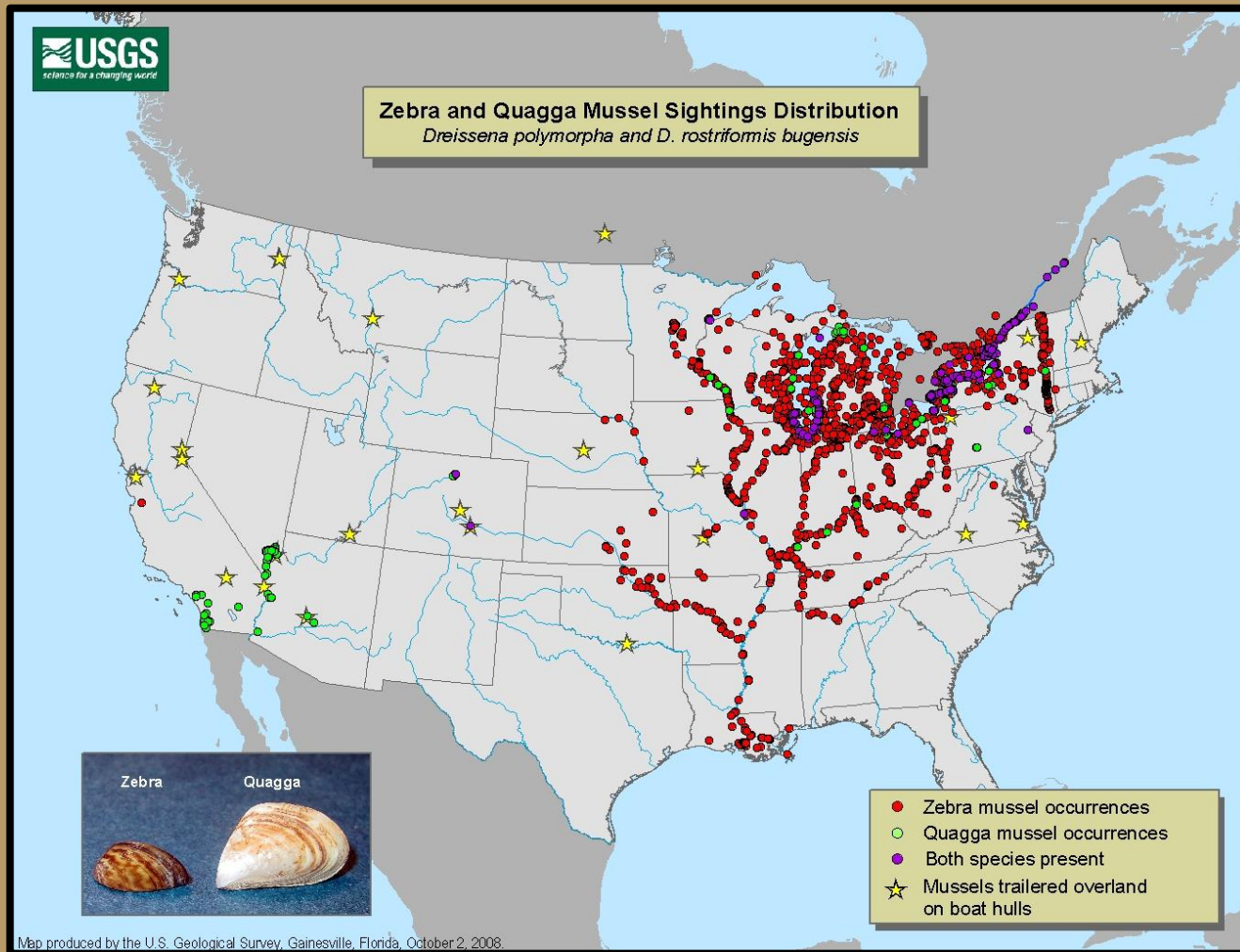
**12,652 samples collected
and analysed at over
1,900 separate locations**

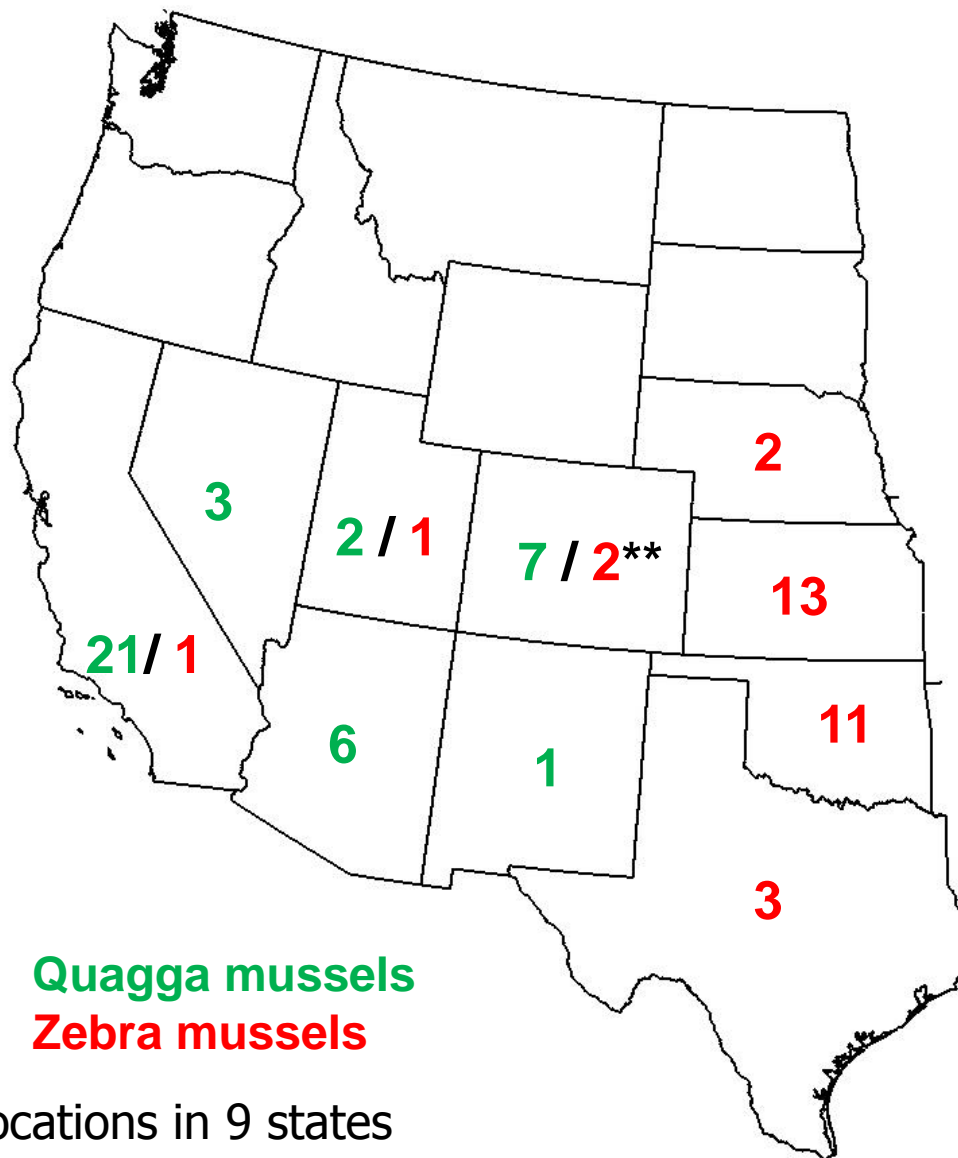
**15 States have
collaborated in this
program**

**By 2015 \approx 15,000
samples analyzed**



Dreissenid Mussel Distribution - 2008

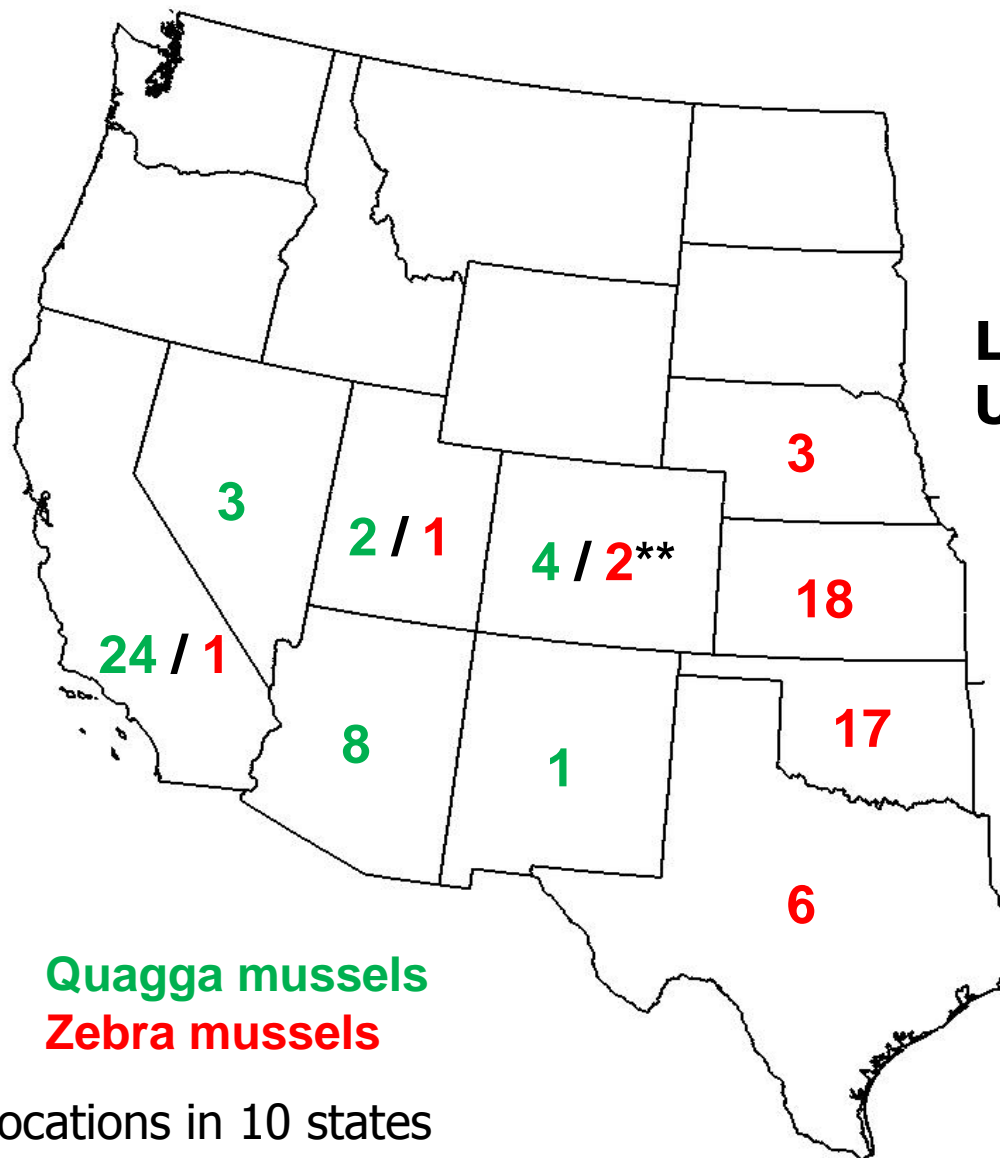




**Locations from
USGS, 1/28/13**

Quagga mussels
Zebra mussels

71 locations in 9 states



**Locations from
USGS, 10/22/13**

****Both zebra and quagga
mussels detected in Lakes
Granby and Pueblo**

Quagga mussels
Zebra mussels

88 locations in 10 states

Locations from USGS, 1/13/15



86 locations in 10 states
- or 123 locations in 14 states?
- or more?

Issues with Early Detection

- Differences in both sampling and analytical methodology can result in different results from different labs
- These differences should be expected
 - Veligers are not always present
 - Most introductions do not result in permanent populations: only <25% of lakes with positive results had veligers detected on 3 or more dates
 - False negatives are common, especially with q-PCR (E-DNA) methods

Case Study: Lake Mead

- **Analysis of the size and distribution of adult mussels indicated that the initial introduction probably occurred 3-5 years before adults were first noticed**
- **Veligers were detected by microscopy in 58% of all Lake Mead samples analyzed by Reclamation in 2007, 88% in 2008, 90% in 2009, 94% in 2010, and 93% in 2011**
- **Western lake managers incorrectly extrapolated these results to other systems**



Photograph by Bryan Moore, NPS

RECLAMATION

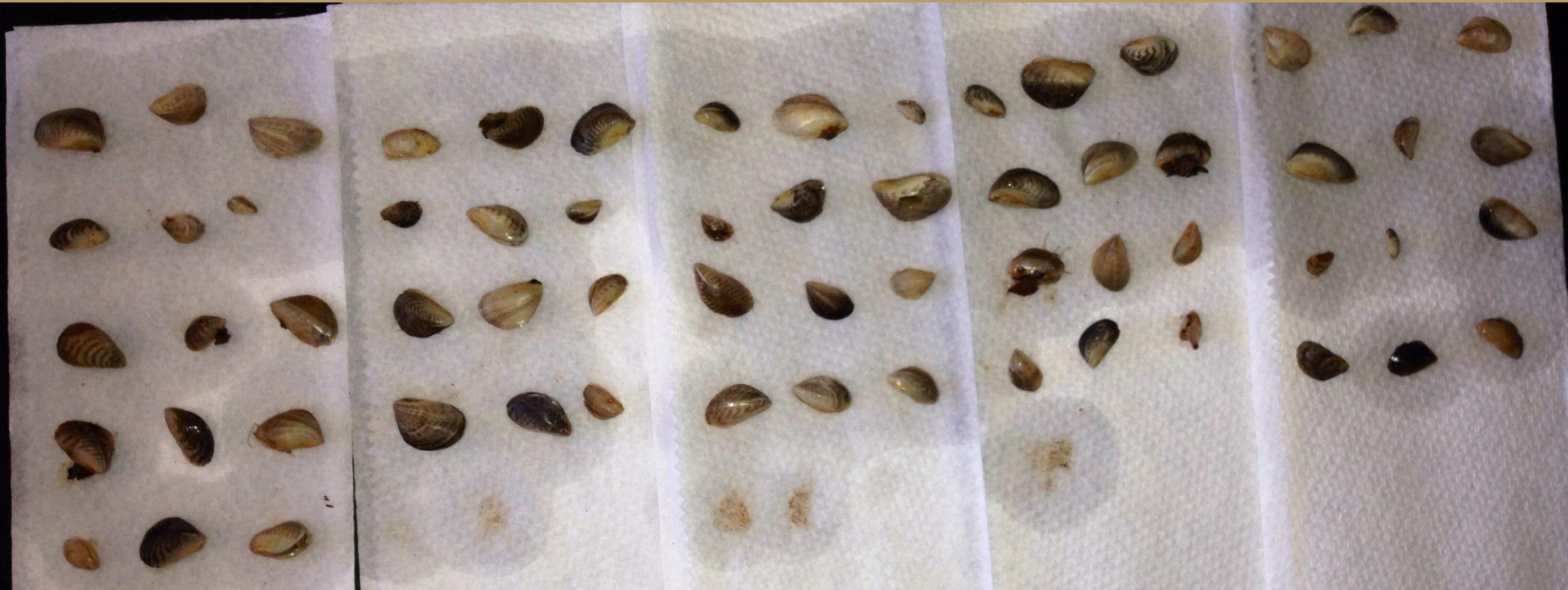
Case Study: Lake Powell

- **Reclamation found veligers in 3 of 8 samples (with 1 suspect) collected at 8 locations in 2007, with 3 samples confirmed positive by PCR**
- **Veliger sampling results for 3/3 samples in 2008, 13/14 samples in 2009, 10/10 samples in 2010, and 13/13 samples in 2011 were negative**

Case Study: Lake Powell

- **17/39 samples in 2012 were positive by CPLM (6), or PCR (12), or both (1), with positives found by both Reclamation and the NPS lab in Utah**
- **Veligers were found from April through November at locations throughout the lake**
- **q-PCR (E-DNA) results were negative for all samples in 2012**
- **Hundreds of adults were found throughout the lake in 2013 although 22/24 veliger samples were negative**

Case Study: Lake Powell



Lake Powell Penstock, 10/24/13
Estimated age = at least 3-5 years

What are the Water Quality Limits for Quagga Mussels?

- **Following conventional wisdom for spawning temperature may have missed mussels in some lakes**
 - Lake Granby, CO – veligers detected at 7 °C
 - The upper spawning range is above 30 °C
- **Calcium, dissolved oxygen concentrations, and pH are also important, but we still do not fully understand limits in the west**
- **We are still analyzing the data to see if we can better identify limiting water quality conditions**

Where do we find them?

- Of 327 positive samples, statistical analysis revealed that **59.3%** positives occurred at a marina/boat launch. Zehfuss (2008)
- Samples analyzed from 2009 to 2012:
Samples analyzed: 11,683
Positive samples: 419 or 4%

52 positive water bodies (excluding known positive waters)	
8 at dam	15%
31 at marina/boat launch	60%
12 at midlake	23%
1 at hatchery	2%
Total	100%

85 positive water bodies (including known positive waters)	
14 at dam	17%
41 at marina/boat launch	48%
13 at midlake	15%
2 at no boating reservoirs	2%
2 at hatchery	2%
4 at a canal	5%
9 in a river	11%
Total	100%

Conclusions from Early Detection Research

- **Early detection monitoring may be able to provide at least a 3-5 year advance warning period before infestations become severe, or even apparent**
- **Conventional wisdom has NOT been a good guide for predicting when or under what conditions veligers will be found**
- **Negative results do not mean mussels are not present and positive results do not mean a lake is infested with mussels**

Coatings Research

- **Purpose:**
 - **Identify effective commercially available coatings products (anti-fouling & foul release)**
- **Status:**
 - **Certain commercially available coatings appear promising**
 - **Limitations with durability**
 - **Galvanizing appears effective for a relatively short period of time**
 - **Scale-up demonstrations under service conditions are underway**

Coatings Research – Panels/Grates



RECLAMATION

Ballast Filter Evaluations

Purpose:

- **Evaluate effectiveness & practicality of 40- and 80-micron filters for excluding veligers from cooling water systems**

• **Status:**

- **Ballast filter installed at Parker Dam in 2009**
- **Higher capacity filters tested at Hoover Dam**
- **Filters can remove veligers in critical areas**

Parker Installation

Installed ballast filter



**Bio-boxes for test
evaluation**

Ultraviolet Light Evaluations (Hoover Dam and Davis Dam)

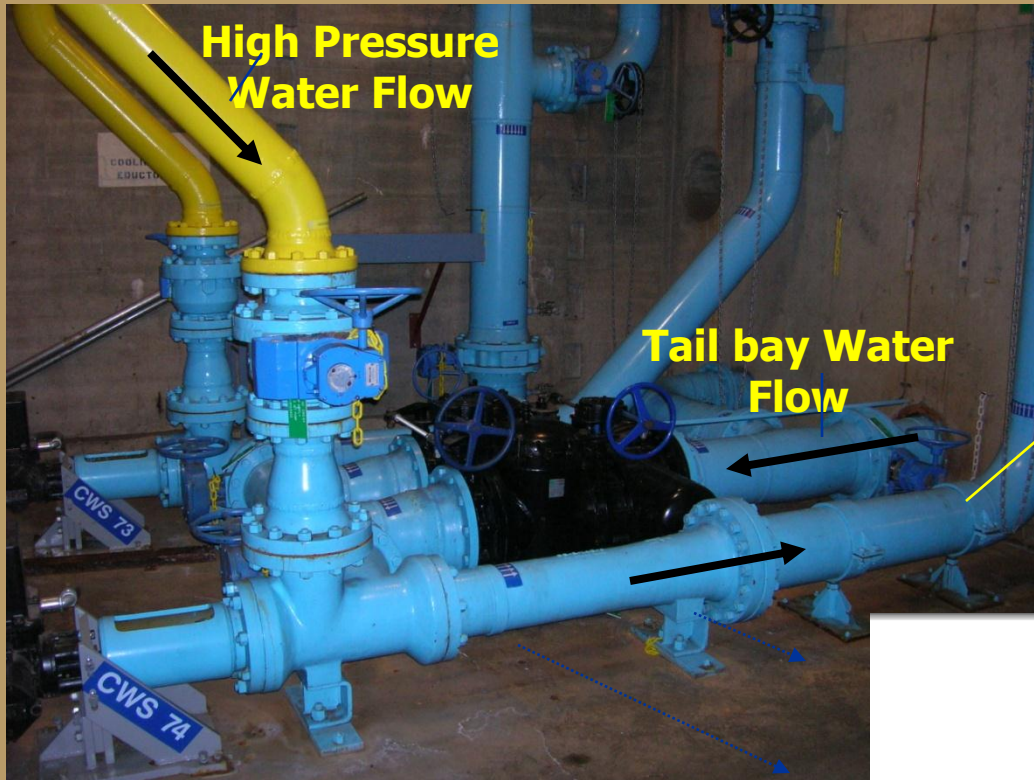
Purpose:

- **Evaluate effectiveness of uv treatment technologies for preventing settlement in cooling water systems**

• Status:

- **Evaluations began in FY2010**
- **Method shows promise – more extensive evaluations are being conducted**

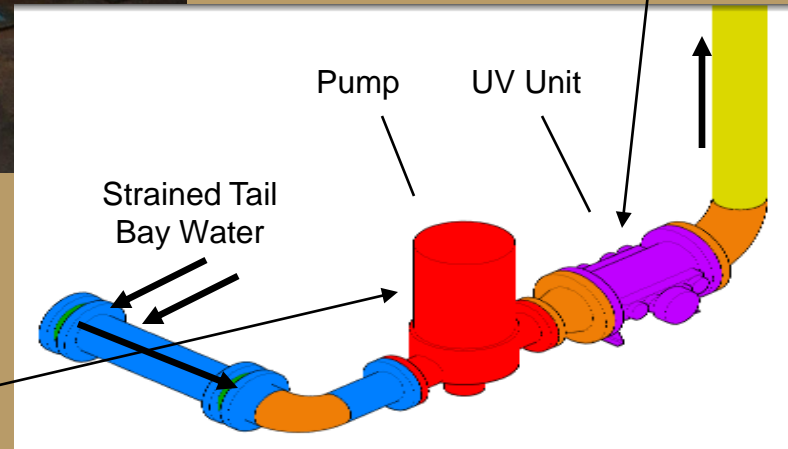
Unit Cooling Water



Combined Unit Cooling Water Supply



New design uses tailbay water supply instead of forebay for pumps at Hoover Dam



Other Research

Water Jetting

- Evaluated effectiveness of commercially available 5,000 psi water jetting system for domestic supply line cleanout at Davis Dam in 2008
- Demonstrated effectiveness of method for removing mussels in 105-ft-length of 10-in pipeline
- Reduced pressures need to be evaluated to avoid removal of coatings

Turbulence

- Impacts of induced turbulence on veliger viability and settling currently under investigation at Davis Dam
- Early results show promise but more testing is needed

Facilities Assessments

- **Facility Vulnerability Assessment Template (www.usbr.gov/mussels/)**
- **Identify features/structures/systems likely to be impacted by an infestation**
- **Assist Regional, Area, and Project Offices with planning should a future infestation occur**
- **Provide information on facility protection technologies**

Questions?



RECLAMATION